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Chapter 6

ANALYSIS OF BUILDING EGRESS

6.1 INTRODUCTION

Chapter 6 documents, to the extent possible, life safety egress features present in the building at the time of the fire on Feb. 20, 2003. A summary of previous incidents in which a significant number of lives have been lost is provided in Appendix C, as well as emergency evacuations that can be classified as successful.

A contract was let to Ove Arup & Partners Massachusetts, Inc. to help document the egress process and life safety features in the building. This chapter is based upon portions of their final report [1], although any conclusions and findings that are presented are solely those of NIST.

The analysis and observations presented depend primarily on the following sources:

- *Providence Journal* – all pertinent published documents;
- *Boston Globe* – all pertinent published documents;
- Town of West Warwick, RI, Building Department – public information on file at the Office of the Town Clerk;
- Town of West Warwick, RI, Fire Department – public information on file at the Office of the Town Clerk;
- National Fire Protection Association (NFPA) – published fire investigations, and historical Life Safety Codes, code handbooks and commentaries;
- International Code Council (ICC) – historical building codes and code commentaries; and
- Rhode Island Attorney General’s Office – public information available regarding the indictments.

Additional information was provided by individuals directly to NIST via email, mail, and telephone calls in response to an appeal to the public.

6.2 ANALYSIS OF EVIDENCE

Chapter 2 of this report provides a timeline for the evacuation based upon the WPRI-TV video.

Additional photographic records, documents, and witness statements have been analyzed to gain a more complete picture of the egress process and associated activities.

6.2.1 Lighting

While the camera operator was evacuating, the fluorescent “black lights” mounted on the ceiling of the club remain on, as do various other lights that are visible on the video. Thus, main power within the club was still on when the camera reached the exterior. The video did not provide evidence as to when the lights inside the club went out. This information would have aided in coordinating some of the eyewitness statements provided later in Chapter 6.

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Lights mounted on the eaves outside of the building were seen to be illuminated throughout the duration of the video up until 0:12:36 video time (0:06:14 fire time). The video did not depict these as illuminated after 0:12:36 video time (0:06:14 fire time). It is not clear if the circuit powering these lights turned off, or if individual fixtures turned off as a direct result of the fire in their vicinity.

6.2.2 Occupant Tracking

A great deal of analysis was carried out to attempt to track occupants as they evacuated the building. The goal was to determine if specific portions of the crowd were able to escape more readily than others and to gain insight as to the pile-up at the front door. The main sources for locating occupants within the building for this analysis were the WPRI video footage panning across the crowd facing the platform, video footage taken while the camera operator evacuated the facility, and video of occupants escaping through windows.

Efforts were made to track individuals from their location in the club when the fire ignited until they had evacuated. One male occupant, shown facing the camera in Figure 6-1, was tracked through evacuation. The time of this still frame is 0:06:51 video time (0:00:29 fire time). The occupant's face has been blurred in the figures below in order to preserve his anonymity; his facial features were not critical for the identification analysis.

After the ignition of the fire, the camera operator began moving towards the main exit before most other occupants did. The camera passed the occupant shown in Figure 6-1 before this individual had begun to evacuate, and he can be seen still facing the platform. At 29 seconds after the ignition of the fire, this individual was seen to turn and to begin moving towards the door. At this point, the camera was approximately two rows of people behind this man (between him and the main exit). This occupant can be seen reaching and crossing the main exit at 0:07:31 video time (0:01:09 fire time), 39 seconds later, in Figure 6-2.

It appears that whether an occupant choosing to exit through the main exit was able to escape or not depended on a combination of two factors: (1) when the occupant decided to begin to evacuate, and (2) where the occupant was located when he/she decided to evacuate. Based on analysis of the video, it appears that the camera operator was located approximately three to six rows back from the platform, chose to evacuate 18 seconds after the ignition of the fire, and was able to exit safely 53 seconds later. The male occupant discussed above was located significantly farther away from the platform (given that the camera operator was seen to pass him in the video), but his evacuation decision was delayed until 29 seconds after the ignition. Because he was farther from the platform and closer to the main exit, he was able to escape safely 39 seconds after he began to evacuate. These observations indicate that generalizations regarding the success of peoples' evacuation attempts cannot be made based purely on either their time to commence evacuation or their location at the beginning of their evacuation efforts. These two factors must be considered in concert.



Figure 6-1. Occupant at Start of Evacuation [2]



Figure 6-2. Occupant Exiting the Building [2]

A number of people were seen early in the video within the club and, after the ignition of the fire, at the exterior. However, based upon the limited video footage of the crowd facing the platform at the start of the concert and during the evacuation, attempting to track other occupants initially located further inside the club was unsuccessful. This is mainly due to the fact that many of the occupants exiting through the vestibule were not originally located in the view of the camera.

6.2.3 Gap in Front Door Egress

Although Figure 6-3 is of poor quality because the camera was in motion at the time, this video frame depicts a series of occupants evacuating through the main exit (note that the white surface at the lower right corner of the frame is one of the open exterior doors). The video time of this still frame is 0:07:33 (0:01:11 fire time). A male and a female are visible near the center of the frame; however, occupants cannot be seen immediately behind them. It would be expected that the occupant density ahead of these

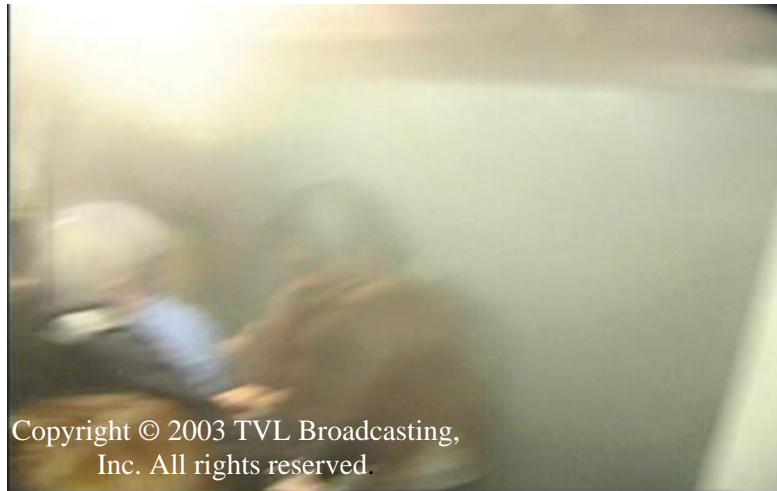


Figure 6-3. Evacuating Occupants [2]

individuals would be similar to the occupant density behind them, given that much of the crowd in the video frames leading up to this frame is noted to be moving towards this door. The lack of occupants visible behind these individuals may suggest that some event occurred to slow or stop further egress. The camera angle shifts away from this door after 0:07:33 (0:01:11 fire time) and does not return to the front door until 0:08:04 (0:01:42 fire time). When the camera returns at 0:08:04 (0:01:42 fire time) a pile-up of occupants is visible. Details regarding how the pile-up occurred are not available from the WPRI-TV video; however, the gap in evacuating occupants during this 31-second period provides insight as to when the pile-up initiated.

6.2.4 Occupants Within Crowd-Crush

Attempts were made to relate individuals observed in the build-up at the main exit door to their locations at the start of the evacuation for the purpose of gaining additional information regarding how and when the pile-up occurred. Due to the limited views afforded by the WPRI video, most individuals could not be tracked. However, the male occupant shown in Figure 6-4 (attempting to evacuate) was also seen in the video near the bottom of the pile-up of occupants shortly later. This occupant was identified by the color of his clothing, gold chain and hairstyle. It appears that this occupant waited at the sidelight of the interior vestibule door (see Figure 6-4), so it is unclear when he was able to join the stream of evacuating occupants. There appears to be one person below him in the pileup of people, implying that he was directly behind or close to the first occupants who tripped or otherwise fell to the ground. According to an interview conducted with the *Providence Journal* [23], the person who appeared to be this occupant

"got into entry hall, it was chaotic with people coming from two directions into foyer, like a funnel. The smoke came in. [The occupant] started pushing and shoving his way to front; 'I could feel myself walking over' people; he could feel the heat on his back. Front doors were open. He was almost out when he tripped over someone who had fallen, and was laying perpendicular to front door. [The occupant] caught himself but as he was halfway up, people behind him fell on top of him. 30-35 people on him. Half his body was out of the door. His waist was where the door was. [He] felt himself being yanked back in. Grabbed bottom metal bar [outside the main entrance]... Finally, [on the] third or fourth pull, [the occupant's] other shoe popped off and he came sliding out."



Figure 6-4 Occupant Attempting to Evacuate [2]

Forty-one seconds elapsed between Figure 6-4 (0:01:02 fire time) and when the occupant was first seen near the bottom of the pile. Because the camera operator moved to the side of the building immediately upon exiting through the main exit, it is not known when the individual shown in these figures reached the door and fell to that position.

A second survivor of the crowd-crush gave the following account, as reported by the *Providence Journal* [41]:

"As the mass followed the most direct route to the doors, [the survivor] detoured around a free-standing wall, and rejoined the river of people on the other side. The force of the crowd behind him was growing. He almost made it to the exit. He tried to stay upright by putting his hands on the person in front of him, but the pressure from behind overwhelmed him. He fell to the floor, two feet from the door. He rolled over to his side and curled up into the fetal position. 'People were piling up on top of me and I could feel the press of people,' he said.... He could breathe in cool, fresh air. He wasn't even hot. But he couldn't move. 'It felt like a football pileup,' he said... 'I didn't want to move because I didn't want the pile to topple on me,' he said. 'I had air and I didn't feel any heat. I wasn't crushed or feeling crushed. I was in a relaxed state. I just felt calm and focused... I knew it was bad because we were stuck there, but I didn't know how bad,' he said. Finally, he felt the load above him lighten as firefighters searched for survivors. He saw a firefighter's boot and reached for it. The firefighter gripped him and wouldn't let go... It took a couple of tugs and [he] was freed."

6.2.5 Eyewitness Statements

Statements from approximately 30 individuals were reviewed for this analysis; those that are relevant to this project are summarized in the following sections. The accounts presented here are quoted from those compiled and published by the *Providence Journal*, *Boston Globe*, Associated Press, and various other sources. In addition, NIST provided an anonymous toll free hotline and an email address for voluntary input from the general public, which generated another 25 communications, none of which contradicted the published accounts.

(i) General accounts of the fire

The statements in this Section refer to the development of the fire and any occupant actions in response to the fire, other than evacuation.

Paul Vanner – Club Employee [3]

After the fire started on the sides of the stage, Vanner moved to the sound control booth towards the back of the concert space and picked up a fire extinguisher that was stored there: “I hit the pin, hit the trigger just to make sure I got something coming out of it. Then I’m heading for the stage. ...a fire extinguisher has no chance against this. We’ve got to get out of here right now.”

Vanner then exited via the kitchen exit, bringing several occupants along with him.

(Note: The *Providence Journal* reported that Kimberly Phillips, a club patron, recalls being hit on the leg by a fire extinguisher as a club employee carried it past her. It is not known if the employee was Vanner, but this confirms that at least one employee obtained a fire extinguisher and advanced towards the stage with it.)

Mario Giamei, Jr. – Former Club Employee [4]

Giamei described the actions of the club’s manager in attempting to re-enter the building to help occupants: “He tried to run back in but he couldn’t; he got knocked back with smoke.”

Robert Riffe – Club Patron [5]

Riffe was attending the concert with a friend on the night of the fire: “I believe I heard someone screaming fire, and I recall someone in the band throw a cup of water on the flames, which of course did nothing.”

Riffe also described the development of the fire that he observed as he evacuated: “Within about 5 seconds of us heading to the door, the flames were already about half way through the first room, and the black smoke had filled the entire club.” It is expected that the “first room” Riffe refers to is the main event space where the stage is located.

(ii) General accounts of the evacuation

This section provides general eyewitness statements of the evacuation of The Station subsequent to the fire. The statements in this section do not refer to any specific portion of the building or its exit components.

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Christopher Travis – Club Patron [6]

Travis was somewhere in the middle of the crowd when the fire started: “Nobody wanted to give up their spot. People felt like it would just be put out.” Travis did not start to evacuate until after the lights in the club had gone out.

Andrea Stewart – Club Patron [7]

Stewart was in the crowd about ten rows back from the stage when the fire started: “It happened so fast. I saw the top of the stage catch on fire... People started to run. All of a sudden, bam! People were pushing me so hard.” Stewart was knocked down and landed in the middle of a pile of people just before the lights in the club went out.

Mark Knott – West Warwick, RI, Police Officer [8]

Officer Knott was located near the club’s main entrance door when people began to evacuate. He was pushed out of the door by the evacuating occupants, and subsequently radioed to the police dispatcher: “Stampede.”

(iii) Accounts of evacuation via the main exit

Many of the occupants of The Station exited (or attempted to exit) through the main exit door at the front of the building. This Section provides several statements describing the evacuation at this location. The Providence Journal reported that 90 occupants exited through the main exit [9].

Robert Riffe – Club Patron [5]

Riffe was attending the concert with a friend on the night of the fire. Upon noticing the growing fire, he and his friend began to evacuate: “We both turned and headed for the main door, which...was the only door we knew of.”

They made their way to the main door: “Just as we reached the point where the two hallways came to one, the thick black smoke just completely filled the room. I couldn’t see, I couldn’t breathe... As I got within inches from the front door way, I just came to a complete stop.”

Once out of the building, Riffe attempted to assist others in evacuating: “I tried pulling on one man and could not get him to even budge the tiniest bit. I grabbed onto a woman who was trapped at the bottom, and could not get her to budge either.”

He eventually left the area of the main entrance and observed the scene from the parking lot:

“...we could see people coming out of the windows...”

Raul Michael Vargas – Club Patron [10]

After deciding to evacuate the club, Vargas states that he encountered numerous people who were not moving and were still watching the stage: “I just picked people up as I went so I wouldn’t trip over them.”

It is unclear if by “picked people up” Vargas means that he got people to evacuate along with him, or if he encountered people who had fallen and lifted them from the floor.

(iv) Accounts of the evacuation via the exit by the main bar

An exit was provided in the main bar area of the club. Numerous eyewitness statements are available describing evacuation efforts in this area, as provided below. The *Providence Journal* reported that 46 occupants exited through the exit by the main bar [9].

Deborah Lemay – Club Patron [11]

Lemay had been in the club several times prior to the night of the fire, and knew of the exit door by the main bar. When the fire broke out, she decided to exit via this door. However, she claims to have experienced difficulty in opening this door. “There was no push bar and I’m looking for a handle and I remember there not being anything to open the door.”

This is contrary to the statements of Robin Petrarca and the video taken inside the club before the fire.

Robin Petrarca – Club Patron [12]

Petrarca, who was a frequent patron of The Station, was located in the main bar area of the club when the fire started. She and a number of her friends escaped through the exit door near the main bar: “Only because we know where the door is...”

Petrarca did not imply that her friend had any trouble in opening this door. Petrarca was pushed out of the door and fell down some stairs: “So many people were just pushing that bodies started coming down the stairs on top of me.”

Rick Sanetti – Club Patron [11]

Sanetti was among the occupants who chose to exit through the door near the main bar area: “It was totally pitch black and you had about 20 of us pushing, and you’re in a state of panic pushing at that door, and it wouldn’t open. The door was functional, but whoever it was [trying to open it] was having a problem getting it open. The door was jammed with people. Had it opened, I assure you, had it opened easily, another 30 or 40 people would have gotten out that door.”

Jason Williams – Band Member of Opening Band *Trip* [13]

Upon noticing the fire, Williams, who had been near the main bar, moved towards the exit door in the main bar area. There, he encountered a crowd, and he attempted to calm people down: “I said something about Chicago, people getting trampled. People seemed to kind of relax for a second. Then, a flood of people came over the bar, flying toward me... the smoke came right behind them, just really fast.”

In the above quote, Williams is referring to a February 18, 2003 incident in a Chicago nightclub in which 21 people were killed and 55 were injured attempting to evacuate through a single door.

Just after the lights in the club went out, Williams decided to back away from the door where people were bunching up, and covered his mouth until he saw an opening to the outside: “As soon as I saw a little glimmer of light, I ran for the door and made it through.”

(v) Accounts of evacuation via the platform exit

A third exit door was located next to the performance platform in the club. The statements below describe evacuation efforts using this exit. The *Providence Journal* reported that 20 occupants exited through the platform exit [9].

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Paul Vanner – Club Employee [3]

Vanner had warned band personnel against placing objects in the path to the door by the stage:
“...you’ve got to move this stuff. That’s a fire exit.”

Walter Castle – Club Patron [11]

Castle attempted to use the door by the stage early in the fire’s development. His statement indicates that he was told by a club employee that the exit was for band members only: “Come to find out it was a band exit....I ended up throwing him out of the way.”

(vi) Accounts of evacuation via the kitchen exit

While technically not an exit per code, a door to the exterior was available in the kitchen area of the club, and several occupants (mostly employees) utilized this door during the evacuation. The statement below describes this door. The *Providence Journal* reported that 12 occupants exited through the kitchen exit [9].

Mario Giamei, Jr. – Former Club Employee [11]

Giamei described the exit located near the club’s kitchen: “It had an exit sign, but unless you’re back in that area, you wouldn’t know it. The way the club was shaped, it was out of the way.”

(vii) Accounts of evacuation through windows

Numerous eyewitness statements suggest that a significant number of occupants escaped through the club’s windows. The *Providence Journal* reported that 79 occupants exited through windows [9].

Anthony Bettencourt – West Warwick, RI, Police Officer [8]

Officer Bettencourt was pushed out of the main exit of the club by the initial rush of people. Once outside, he apparently heard people kicking at windows, and proceeded to break some of these windows with his baton. He and other officers helped numerous people, both conscious and unconscious, exit through the windows.

Eventually, the officers could no longer reach people immediately inside the windows, and began to call for occupants: “Come to the window.”

According to Bettencourt, one occupant ran through one of the windows: “He opened up a nice hole.”

Robert Riffe – Club Patron [5]

After being stopped at the main entrance by the build-up of people, he was able to struggle free from the pile and to get out of the building. He observed the scene from the parking lot.

“...we could see people coming out of the windows, and people scattered throughout the parking lot. Some...were all bloodied from jumping out of the windows and onto the pavement.”

Paul Vanner – Club Employee [3]

After deciding against attempting to fight the fire with a fire extinguisher, Vanner evacuated through the kitchen door. He then moved around towards the front of the building.

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"All of a sudden, I heard smash-smash-smash, people kicking out the windows. It was like black oozy smoke when they started kicking those windows out."

(viii) Accounts of when the lights failed

Several accounts suggest that the lighting failed after the pile-up occurred.

Andrea Stewart – Club Patron [7]

Stewart was in the crowd about ten rows back from the stage when the fire started.

Stewart was knocked down and landed in the middle of a pile of people just before the lights in the club went out.

Deborah Lemay – Club Patron [11]

Lemay had been in the club several times prior to the night of the fire, and knew of the exit door by the main bar. When the fire broke out, she decided to exit via this door.

"When the lights went off. I was almost at the door. I remember turning around and seeing the black smoke rolling in. Then I became engulfed in smoke."

6.2.6 Summary of Additional Evacuation Analysis Observations

The analyses of the WPRI video and the available eyewitness statements have generated numerous observations in addition to the fire and evacuation timeline presented above. These are summarized below.

- It is apparent that many people did not immediately move upon first noticing the flames. This may have occurred because people initially believed that it was "part of the show" or wished to maintain their locations within the crowd for the rest of the show. This may also have occurred because the occupants were apparently not instructed by the club's staff to begin evacuation. People appear to have initially felt that the fire would be controlled. These factors caused a significant delay in the evacuation of many occupants.
- Some of the occupants seem to have known of the existence of the side exit door near the main bar. The *Providence Journal* identified survivors of the February 20, 2003 fire at The Station [14]. According to this article, approximately 46 occupants used this exit. However, difficulty in opening this door, for unknown reasons, was reported by several survivors (but not all survivors that exited through this door reported difficulty). In the WPRI video, this door appears to have panic hardware and to swing in the direction of egress. Eyewitness statements confirm that occupants were able to evacuate through this door.
- Some occupants who used the side exit near the main bar reported falling down a series of stairs immediately after passing through the door. Video footage or photographs of the evacuation efforts at this location are not available; however, this door exits onto a landing with steps to grade.
- A small number of occupants (approximately 20 - mainly those associated with the band or the club, as reported by the *Providence Journal* [14] used the exit near the platform early in the fire. It is apparent from the WPRI video that this exit rapidly became impassable; the camera observed significant flames in the area of this door when the camera operator first made his way to the side of the building at 1 minute 25 seconds after the start of the fire. Thus, it is likely that smoke and

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flames blocked this exit within 1 minute 25 seconds of the start of the fire. At 4 minutes 30 seconds after the start of the fire, dense smoke and flames could be seen down to the floor level just inside of the platform exit.

- Multiple survivors described the evacuation as “panicked” or likened it to a “stampede.” [6-8].
- Many survivors indicated that they were not aware of any exit doors other than the main front door.
- Numerous occupants (approximately 79) exited the building through its windows. Many were assisted by individuals, including police officers, on the outside of the building.
- Some attempts were made at initiating manual extinguishment of the fire. One band member attempted to douse the flames with a bottle of water, while another ran for a fire extinguisher (but never actuated it). Based upon eyewitness statements and observations from the WPRI-TV video regarding the fire growth, manual extinguishment efforts when initiated were ineffective against the fire.

6.3 ESTIMATES OF OCCUPANT LOAD

Based upon the 2003 editions of the IBC and NFPA 5000 model building codes, the estimated permitted occupant load for a building similar to The Station in area and use varies (See Section 7.3.11), but is equal to 420 people when limited by egress from properly functioning doors at the main entrance, platform, and bar exits.

Several public documents from the Town of West Warwick were found that referred to occupant loads in The Station or its previous incarnations. One, dated Nov. 21, 1981 [16], was an Application for Variation under the Fire Safety Code to omit completely enclosing the boiler room, which identified an occupant load of 225 for the building as it was being used at the time. The West Warwick Fire Department, in a memorandum dated Dec. 30, 1999 [17], identified the occupant load as 253 occupants; however, an allowance was given to increase the occupancy to 317 by removing tables and chairs from three lounge areas and providing standing room only in those areas. No other distribution for the memorandum is indicated on the document. A third document was an unsigned memorandum on blank bond without letterhead from the West Warwick Fire Department, dated Mar. 2, 2000 [18], addressed to Chief Peter Brousseau. Again, no other distribution is shown. The memorandum identified the occupant load as 258 when tables and chairs were set up in the four designated seating areas; however, an allowance was given to increase the occupancy to 404 by removing all tables and chairs. The memorandum also stated that a uniformed firefighter should be on the premises if this higher occupancy were to be applied. No explanation has been obtained for why the memorandum was written, nor does NIST know if either of the memoranda was made available to the owners of the building.

Published articles were reviewed in an attempt to develop estimates of the number of occupants at The Station during the incident. The *Providence Journal* identified the names of 100 people who died as well as the names of the survivors of the Feb. 20, 2003 fire at The Station [14]. Survivors are listed by source of identification. According to the *Providence Journal*, 208 survivors were interviewed; of those interviewed, 59 were identified by other survivors, 46 were identified by lawyers, 10 were identified by relatives, 5 were identified by hospital staff and two photographers were taking pictures in the club. The *Providence Journal* lists ages, town of residence, and state of residence for 274 of these people, list a total 430 occupants in October 2003 [14], 432 in December 2003 [9], and 440 in Feb. 2004 [40]. Independent information was not available to confirm this total.

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To the degree possible, the WPRI-TV video taken in The Station on the night of the incident [2] was used to provide an alternative estimate of the actual number of occupants within the club; however, several factors limited the accuracy and comprehensiveness of the count:

- A camera has a limited view, or “cone of vision.” As the operator moved around, he was only able to capture occupants within the camera’s view; and thus, in many cases additional occupants at the periphery of the camera’s view were not recorded.
- A single sequence in which the camera pans in a full circle and thus shows the entirety of the club at a given time was not available. Thus, at any given time, the camera is only showing the occupants of one portion of the club, and the occupant load conditions in the rest of the club are unknown.
- The first part off the video was recorded over an unknown amount of time, and includes several “cuts” or stop points when the camera was turned off for an unknown portion of time. During such cuts, occupants were likely to have moved around the club, and new occupants likely entered.
- The dark conditions of the club through most of the evening created shadows in areas distant from the light of the camera. Occupants located in these shadows were generally not visible.

With the above limitations in mind, a series of still frames that provide a panning view of the club’s performance assembly area were obtained from the WPRI-TV video. These frames are shown in sequence in Figures 6-5 through 6-8 as the camera pans from right to left. The occupants shown in these still frames were counted in an effort to derive an approximate occupant load for the area shown. Orange dots have been used to represent counted occupants. The yellow lines in these Figures represent the boundaries where the frames overlap. A total of 144 occupants can be seen in these four figures.



Figure 6-5. Occupant Load Count, Part1 – 45 Occupants



Figure 6-6. Occupant Load Count, Part 2 – 42 Occupants



Figure 6-7. Occupant Load Count, Part 3 – 37 Occupants



Figure 6-8. Occupant Load Count, Part 4 – 20 Occupants

It is not clear at what time in relation to the start of the concert this video sequence was recorded. If it was recorded well before the main musical act, then it is likely that many occupants were located outside of the main platform viewing area at this time (i.e., many occupants may have been near one of the bars, in the pool room, or in the restrooms). Conversely, if this sequence was recorded immediately prior to the start of the primary musical act, then it is likely that the majority of the club's occupants would have moved towards the platform and into the performance assembly area. For these reasons it is not possible to extrapolate to a total building occupant load from this analysis. However, these figures can be helpful in estimating possible ranges of the number of occupants that may have been within the main platform viewing area.

6.4 LIFE SAFETY FEATURES

Multiple data sources were reviewed to assist in determining the life safety features present at The Station at the time of the fire on Feb. 20, 2003. The following section documents the results of this effort. The information is divided into three categories:

- **Public Documentation Evidence:** This includes data from Fire Department Inspections, Fire Alarm Company Sketches and Reports, and other publicly available documentation.
- **Photographic Evidence:** This includes information obtained from a review of the digital photographs and scanned images received from NIST.
- **Video Evidence:** This includes information extracted from the WPRI video footage of the incident.

6.4.1 Floor Surfaces

It has been claimed that floor surfaces in The Station were uneven [22]. NIST has no independent information to confirm or contradict this claim.

6.4.2 Exit Doors

Egress through the main entrance to the building was limited by a single interior door (LSF 6 in Figure 6-10) not the double doors that could be seen from outside the building.

The West Warwick Fire Department Inspection Report dated Nov. 10, 2001, commented that the exit door near the platform cannot swing inward [24]. The building owner was instructed to call when ready for re-inspection. Note that these comments were checked and deemed “OK”; however, the re-inspection signature is blank.

In a West Warwick Fire Department Inspection Report dated Nov. 20, 2002 [25], the following comments were made:

- Platform exit door swings in the wrong direction;
- Panic hardware on platform door is broken.

The building owner was instructed to call when ready for re-inspection. These comments were checked and deemed “OK”; however, the re-inspection signature is blank.

6.4.3 Exit Signs

Numerous West Warwick Fire Department reports were issued to previous businesses on this site regarding the exit signs. In reports dated Sept. 25, 1993 [26], Nov. 17, 1994 [27], Oct. 2, 1995 [28], Sept. 25, 1996 [29], and Nov. 22, 1998 [30], the condition, arrangement, and operation of the exits signs were noted as “OK”. These reports did not require re-inspection.

The West Warwick Fire Department Inspection Report dated Nov. 10, 2001 [24], commented that the exit sign near main entrance needs bulbs. The building owner was instructed to call when the building was ready for re-inspection. Note that this issue was checked and deemed “OK”, although re-inspection signature on the report is blank.

The West Warwick Fire Department Inspection Report dated Nov. 20, 2002 commented that the exit signs were not working [25]. The building owner was again instructed to call when the building was ready for re-inspection. Note that these issues were checked and deemed “OK”, although the re-inspection signature is blank on this report as well.

6.4.4 Emergency Lighting

The West Warwick Fire Department inspected the emergency lighting within the building under previous ownership on numerous occasions. In Inspection Reports dated Sept. 25, 1993 [26], Oct. 2, 1995 [28], Sept. 25, 1996 [29], and Nov. 22, 1998 [30], the condition and operation of the emergency lighting within the building were noted as “OK” and re-inspection was not called for.

In a West Warwick Fire Department Inspection Report dated Nov. 17, 1994, the kitchen emergency lighting was noted as not working. The owner was instructed to notify the Fire Department when the repairs were completed; note that the re-inspection signature is blank [27].

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The West Warwick Fire Department Inspection Report dated Nov. 10, 2001, commented that the emergency lighting units at main entrance and at platform were not working [24]. The building owner was instructed to call when the building was ready for re-inspection. These issues were rechecked and deemed “OK”, although the re-inspection signature on the report is blank.

6.4.5 Suppression

The West Warwick Fire Department carried out numerous inspections of the manual suppression equipment in businesses at this site. The Fire Department issued reports on Sept. 25, 1993 [26], Nov. 17, 1994 [27], Oct. 2, 1995 [28], Sept. 25, 1996 [29], and Nov. 22, 1998 [30], deeming the condition and location of the existing fire extinguishers “OK”, and re-inspection was not required.

The West Warwick Fire Department Inspection Report dated Nov. 10, 2001, commented that the fire extinguishers must be hung [24]. The building owner was instructed to call when the fire extinguishers were ready for re-inspection. This issue was rechecked and deemed “OK”, although the re-inspection signature on the report is blank.

6.4.6 Fire Alarm and Detection

(i) Fire alarm company information

An inspection report from RI-CONN Fire Systems, Inc. [31] verifies the testing of the following system components:

- four heat detectors in the kitchen and basement;
- two manual stations – one at the kitchen exit and one at the bar;
- the kitchen hood suppression system was also tested.

Fire alarm sketches prepared by New England Custom Alarms [32], indicate existing system devices and various device additions to upgrade the fire alarm system at The Station. This work was permitted on Mar.8, 2000; it appears that this work was completed.

The existing drawings located the following life safety devices:

- two heat detectors in the space between the Kitchen and the Employee Restroom Area;
- one heat detector in the Employee Restroom;
- an Ansul system in the kitchen (presumably protecting cooking appliances);
- one alarm horn near the kitchen door adjacent to the large bar;
- one alarm horn in the greenhouse near the pool tables;
- one alarm horn adjacent to the platform exit door;
- two heat detectors in the basement.

The upgrades included on the Mar. 6, 2000, drawings resulted in the following:

- a new Fire Alarm Control Panel inside the main entrance doors.
- one existing heat detector in the space between the kitchen and the employee restroom/prep area (one of the heat detectors was to be removed);

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- one heat detector in the prep area (moved from the employee restroom);
- an existing Ansul system in the kitchen (presumably protecting cooking appliances);
- one new heat detector below the platform;
- one new heat detector above the platform;
- one new heat detector backstage;
- one existing alarm horn near the kitchen door adjacent to the large bar;
- one existing alarm horn in the greenhouse near the pool tables;
- one existing alarm horn adjacent to the platform exit door;
- one new alarm horn in the hallway to the restrooms.
- four new manual pull stations (inside front door, at platform door, at left side bar area door, and at light/sound control area);
- two existing heat detectors in the basement.

An NFPA 72 Inspection and Testing form [33] lists the following fire alarm system components:

- three manual stations;
- six heat detectors;
- one Ansul tie-in;
- four horns;
- five strobes;
- one speaker.

The device testing section of the same form [33] confirms that the following initiating and supervisory devices were inspected and tested:

- one heat detector in the Kitchen;
- one heat detector in the Prep Area;
- one heat detector in the Dining Area;
- one heat detector in the Employee Restroom;
- two heat detectors in the Basement;
- two pull stations (location is not specified);
- Ansul system was visually inspected and its operation was simulated.

6.4.7 Interior Finish

In letters dated May 22, 2003 [34] and May 23, 2003 [35], the West Warwick Fire Chief and the West Warwick Building Official, respectively, responded to the West Warwick Town Clerk regarding requests for permits or inspections from The Station for the use of decorative or acoustic materials. No information was found by either individual with regard to a request from The Station for permitting or inspection of decorative or acoustic material usage.

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6.4.8 Identification of In-place Life Safety Features

Table 6-1 summarizes all identified life safety features within The Station prior to the fire. Refer to Figure 6-9 for the locations of these features within the building. Specific devices and features are shown

Table 6-1. Summary of Identified Life Safety Devices

Image ID	Description
LSF 1.	Main double doors with ramp and stairs. (Note that egress was limited by the single interior door (LSF 6), not the main double doors.)
LSF 2.	Exterior stairs from the left-side main bar area indicating location of exit door.
LSF 3.	Exterior stairs from the kitchen area indicating location of exit door.
LSF 4.	Exterior stairs from the platform area indicating the location of exit door.
LSF 5.	Site view indicating the location of the doorway from the main bar area to the ticket area.
LSF 6.	Door leading from the interior ticket area towards the outer vestibule.
LSF 7.	Exit door from the left side of the main bar area to the exterior concrete stairs. Panic hardware was provided on this door.
LSF 8.	Exit door adjacent to the platform to the exterior concrete stairs. Panic hardware was provided on this door. Note that it appears there was foam attached to this door and that there was an additional interior door that swung against the egress direction.
LSF 9.	Exit sign located near the rear bar; it appears to be pointing toward the kitchen exit door.
LSF 10.	Exit sign above the door that leads from the ticket area to the front vestibule.
LSF 11.	Exit sign above the platform door. Note that in this image the sign is clearly illuminated.
LSF 12.	Exit sign above the platform door on February 20, 2003. Note that in this image the sign does not appear to be illuminated. NOTE: This is a duplicate of LSF 12, but was included to show that the exit sign may not have always been illuminated.
LSF 13.	Two exit signs. One located in the main floor area with an arrow towards the ticket area and another above the ticket area doors leading to the front vestibule.
LSF 14.	Exit sign over the left side main bar area exit door.
LSF 15.	Exit sign located in the front vestibule above the main double exit doors. This location is based upon similar wall and ceiling features observed in the WPRI video.
LSF 16.	Emergency light located near the rear bar.
LSF 17.	Emergency light above and to the right of the platform exit door.
LSF 18.	Emergency light on the wall adjacent to the kitchen by the main bar facing into the main floor area.
LSF 19.	Emergency light above and to the right of the left side exit door from the main bar area.
LSF 20.	Fire extinguisher located behind the rear bar.
LSF 21.	Detector (heat) located above the lighting grid on the ceiling near the platform.
LSF 22.	Fire alarm strobe adjacent to the exit sign above the platform exit door.
LSF 23.	Fire alarm strobe on the ceiling to the left and in front of the platform.
LSF 24.	Fire alarm strobe on the wall adjacent to the exit sign in the main floor area pointing toward the ticket area.

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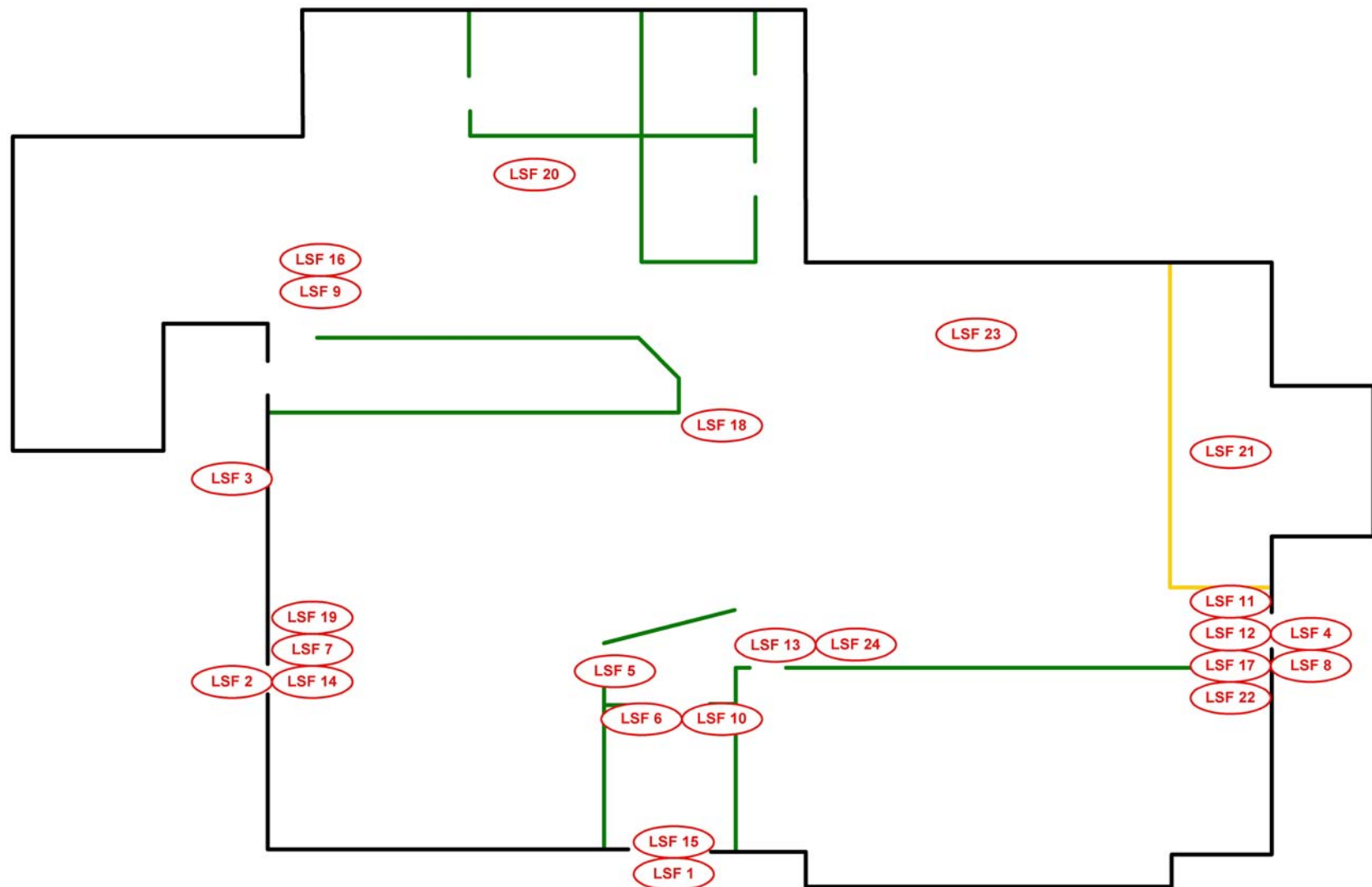


Figure 6-9. Locations of life safety features listed in Table 6-1.

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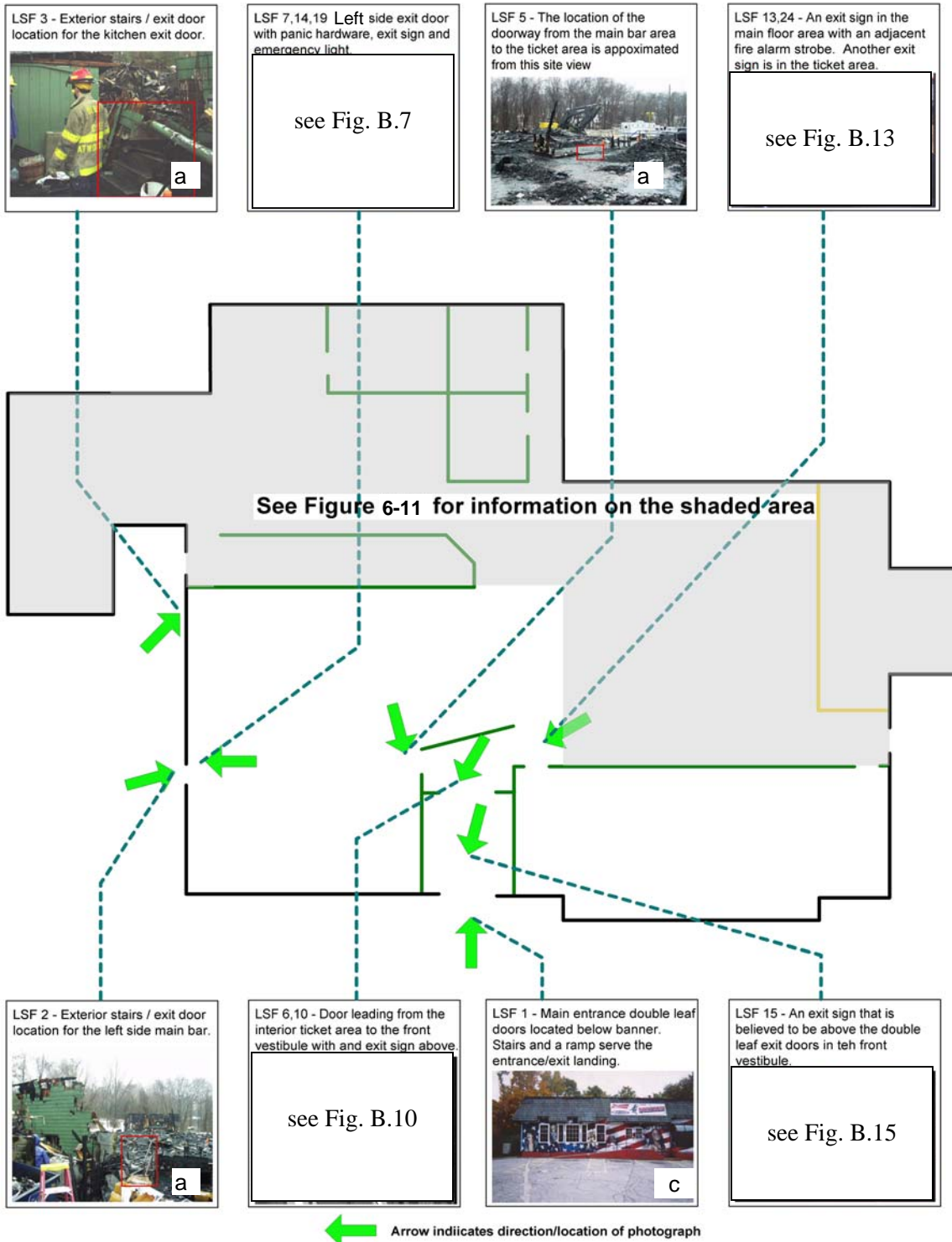


Figure 6-10. Summary of Life Safety Features – Part 1

a - photo by NIST; c - photo with permission of A. Baldino, III

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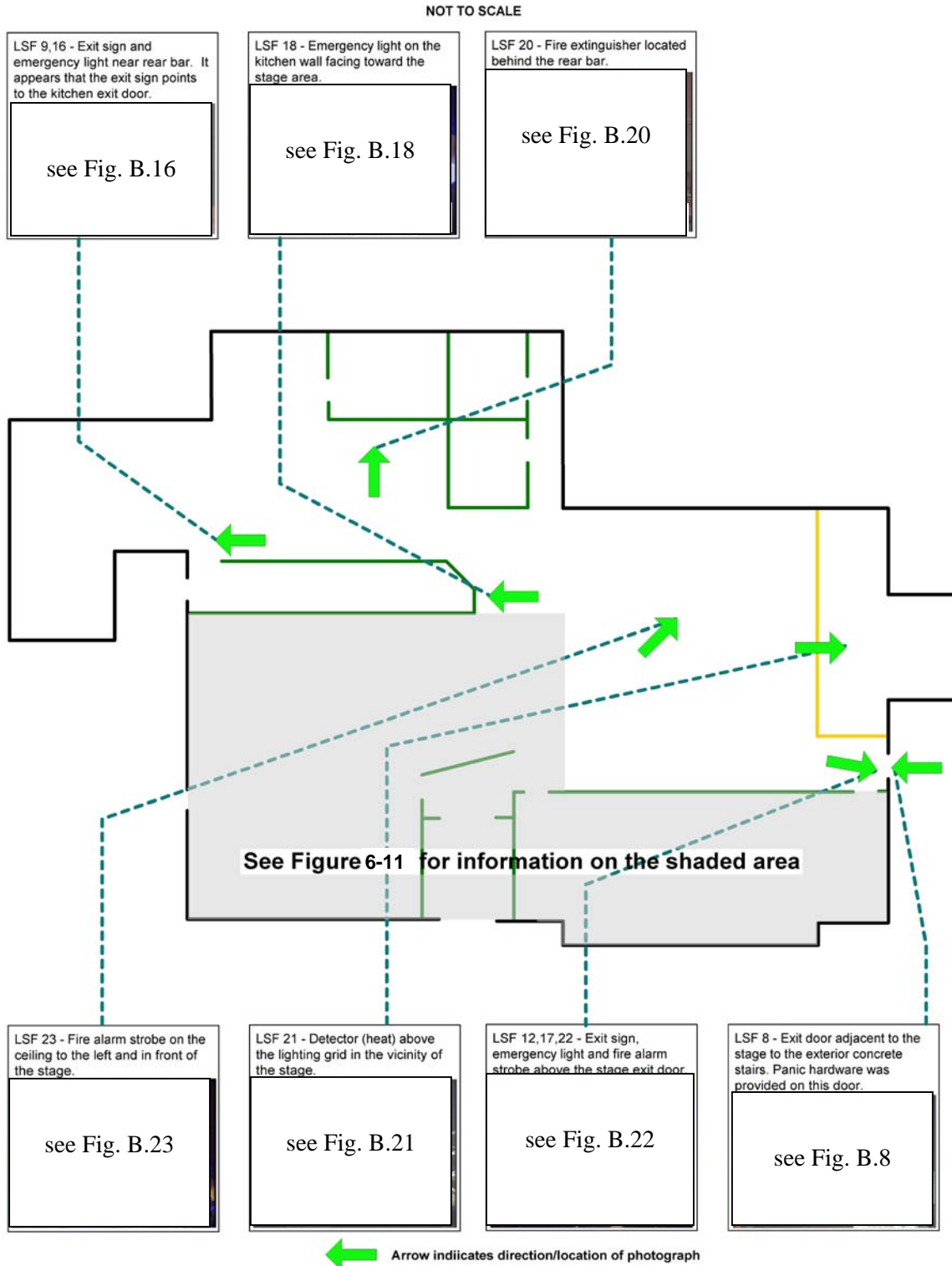


Figure 6-11. Summary of Life Safety Features – Part 2

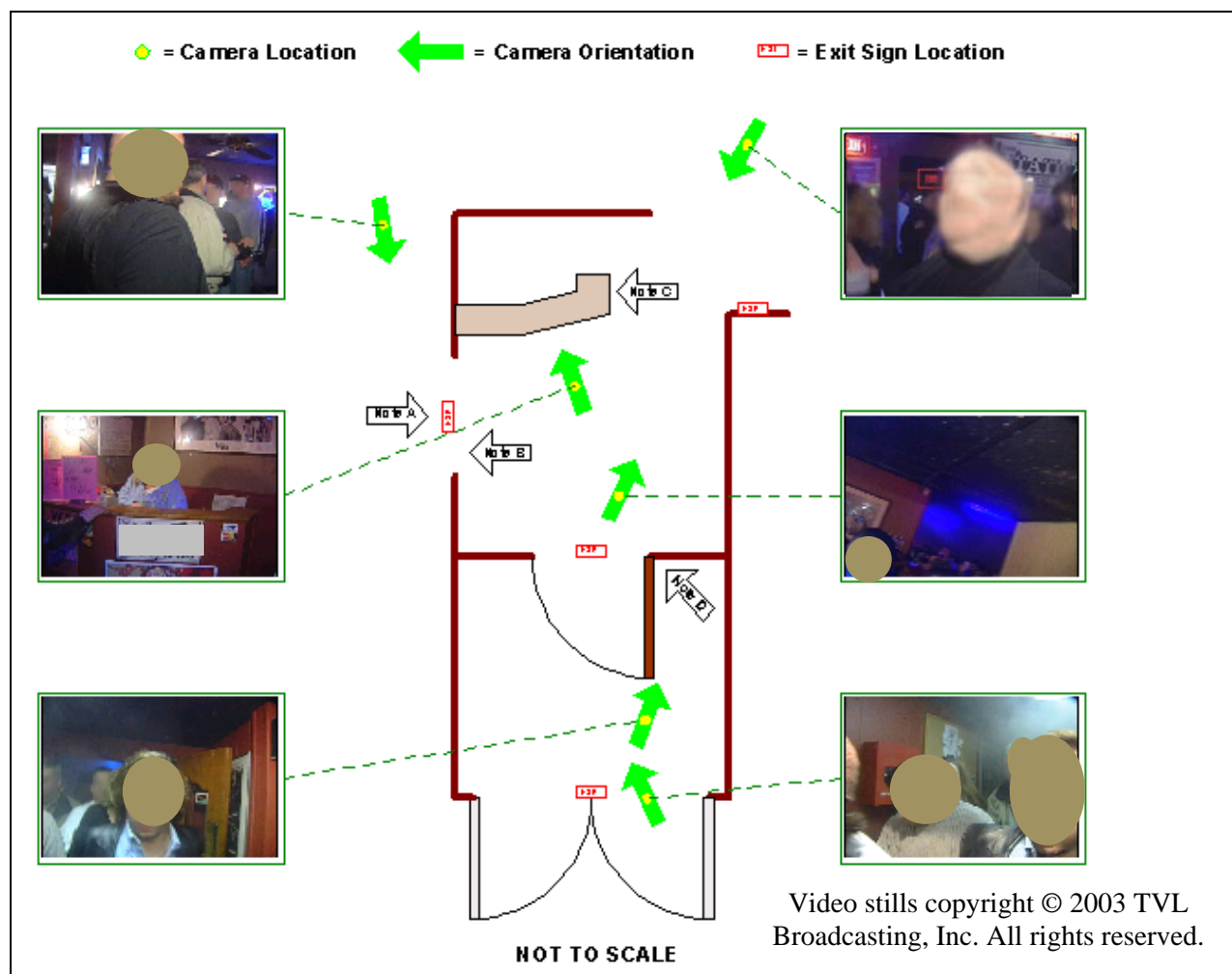


Figure 6-12. Detail of Main Exit Vestibule Area (Video frames copyright © 2003 TVL Broadcasting, Inc. All rights reserved)

Note A: Photograph or video evidence specifically showing the exact location of this exit sign above the secondary vestibule doorway was not available. However, the sign was observed in the WPRI video in a reflection in the mirror behind the main bar.

Note B: Photograph or video evidence specifically showing the exact location and size of the secondary vestibule doorway was not available. This representation is approximate based upon the video evidence available.

Note C: The dimensions of the ticket counter are not known. This representation is approximate based upon the video evidence available.

Note D: The dimensions of the associated sidelights are not known, although the orientation shown here is accurate based upon video evidence. Note that the single inner door provides the limit to egress, not the exterior double doors.

The uncertainty in the transverse position of the camera is estimated to be +/- 1 ft; it is not possible to estimate the uncertainty in position of the camera along the direction of the arrow since the zoom setting is unknown.



Figure 6-13. Exit Door Near Platform [2]

in Figures 6-10 and 6-11, taken from video stills or photographs taken at the site on Feb. 22, 2003. (Large format copies of the photos are included in Appendix B.) Additional details, such as manufacturer names, model numbers, or other descriptions of the devices were not available.

Several additional observations were made regarding the main exit vestibule area and the exit door near the platform. Figure 6-12 provides an approximate representation of the orientation and layout of the main exit vestibule area. It also shows the video evidence that was used to formulate this representation. The notes provided with this Figure give some additional observations related to this exit. Figure 6-13 shows the exit door located in the vicinity of the platform. Based upon this video still and other frames from this portion of the WPRI video, it appears that this exit included two doors:

- an exterior door, which swung outward, or with the direction of egress travel, and
- an interior door, which swung inward, or against the direction of egress travel.

The presence of the interior door is evident from the inward-swinging hinges seen on the doorframe. The edge of this door is visible as well. As can be seen in Figure 6-14 the exterior door was equipped with panic hardware. The hardware installed on the interior door is unclear. Additional examination of this figure reveals what appears to be adhesive on the inside of the exterior door.

6.5 LOCATION OF VICTIMS RECOVERED FROM THE SCENE

The Rhode Island Attorney General's office released a diagram of the approximate location where the rescuers recovered the 96 people who died at the scene of the fire [36]. (See Figure 6-14.) Based upon interviews with witnesses reported by the *Providence Journal* and the distribution of the victims shown in Figure 6-14, about 2/3 of the occupants appear to have attempted to leave through the main entrance in the front of the building; however, only about 40% of those who successfully evacuated escaped through the main entrance.

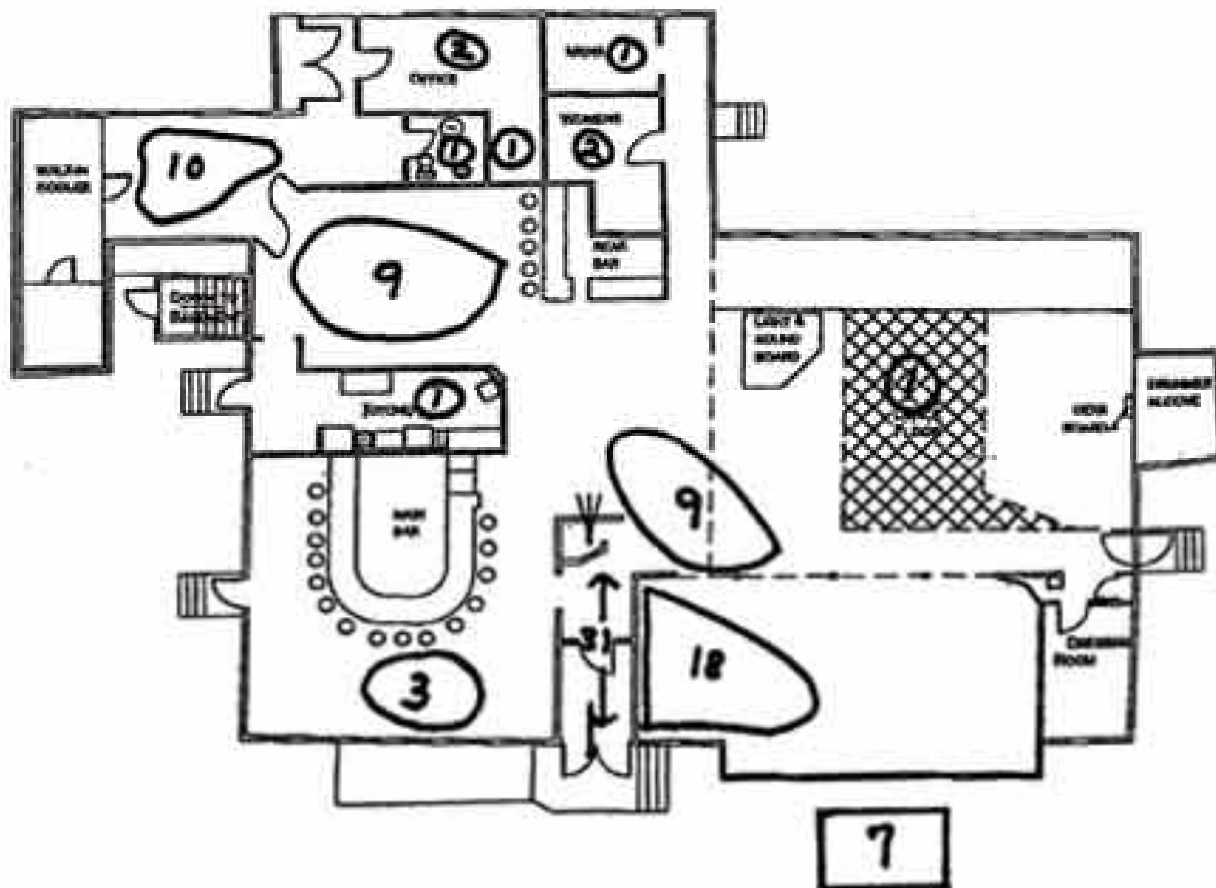


Figure 6-14. Location of Recovered People Who Died at Scene [36]

A little over half of all people who successfully escaped via the doors (main entrance plus main bar plus kitchen plus platform door) exited via the main entrance. The windows in the main bar room and the sunroom appear to have become the secondary routes of escape once the main entrance became impassible, and accounted for over 1/3 of the successful evacuations.

The small number of victims found in the main bar room suggests that the main bar room exit door and windows provided open routes to escape for a time period about as long as it took to reach untenable

conditions in that area of the building. By contrast, the high number of victims found in the sunroom relatively close to the windows suggests that the environment there became untenable quickly, eliminating the option of a secondary route through the sunroom windows once the platform door and main entrance became unusable. Both of these conclusions are consistent with the environmental conditions predicted in the FDS simulations discussed in Chapter 5.

A significant number of victims were found in the dart room, storage area, and office, suggesting either that they were unfamiliar with the building and hoped to find a safe exit in that region, or that they became disoriented while heading for the side exit of the main bar room (or possibly the kitchen exit). It is unclear whether the seven people identified in Figure 6-14 as being recovered from the front of the building outside of the sunroom died as they escaped or were pulled from the sunroom by rescuers.

6.6 ALTERNATIVE SIMULATIONS OF NIGHTCLUB EVACUATION SCENARIOS

The following questions were posed by the investigation team regarding the evacuation from the nightclub:

1. How long would it take to evacuate a building similar to The Station with no fire present assuming exit numbers, exit widths, and occupancy limits were consistent with current national model building codes (see chapter 7 for details)?
2. How long would it have taken to evacuate The Station assuming the platform door became impassable in 30 seconds and the main entrance in front became blocked in 90 seconds?
3. How long would it take to evacuate a building similar to The Station assuming that the doorway near the ticket-taker was the same width as the double doors leading to the outside and that it did not become blocked, but that the platform door became impassable in 30 seconds?

The first question is important to answer since it forms the basis of model code provisions. The second question is a challenge to our ability to predict reality when it comes to an emergency evacuation. The third question provides insight into the effectiveness of a possible change in model code requirements.

The Station had four exit paths: through the main entrance, the main barroom, the kitchen, and the platform area. Based upon current model codes, the kitchen door was not accessible to the patrons. As mentioned in Chapter 6.3 and discussed in more detail in Chapter 7.3, the occupancy limit based upon current model code provisions for safe egress from the building as it was used on Feb. 20, 2003, was 420. With these data as input, and the floor plan from Chapter 1, the evacuation time was estimated using two commercial software packages, Simulex [36, 37] and buildingEXODUS [38].

To run these models it was necessary to distribute the 420 occupants throughout the building. It was assumed that the dance floor and area around the platform were at the maximum density permitted by the current national model codes described in chapter 7, 2.17 persons/m² (5 ft²/person), that the sunroom and raised area around the dance floor had a density of 1.56 persons/m² (7 ft²/person), that the main barroom and back room were populated at 0.72 persons/m² (15 ft²/person), and that the 36 remaining occupants were scattered about the kitchen, behind the bar, restrooms, storage area, dressing room, and corridor. Simulex and buildingEXODUS also needed to have a pre-movement time assigned as well as an algorithm for selecting exits. For all cases examined the pre-movement time was assumed to be zero, and the occupants were instructed to always select the closest exit.

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Table 6-2 summarizes the results of the simulations. The scenario number in column one corresponds to the questions posed above. The total times to evacuate and the number of people through each of the

Table 6-2. Summary of calculated evacuation times (seconds) and total occupants out each exit

Scenario	Total Evacuation Time	Occupants to Front Door	Occupants to Platform Door	Occupants to Kitchen Door	Occupants to Main Bar Door	Total Remaining at 90 s
1 (Simulex)	188 s	213	184	3	20	166
1 (EXODUS)	202 s	214	180	4	22	208
2 (EXODUS)	330 s	91	32	3	273	271
3 (Simulex)	198 s	358	39	3	20	173
3 (EXODUS)	194 s	363	33	4	20	201
2* (Simulex)	308 s	356	39	3	22	256
2* (EXODUS)	341 s	364	32	4	20	274

available doors are listed in the other columns, corresponding to the scenarios and the simulation model used in column 1. *For a building meeting current national model code requirements at maximum occupant load* (scenario 1), the time needed to evacuate with no fire or smoke present was calculated to be 195 seconds \pm 7 seconds for the two simulations. The flow through the various exits was about the same for both calculation methods, with just over 50 % of the occupants evacuating through the front door.

buildingEXODUS was used to evaluate the scenario in question 2, in which the *platform door became impassable in 30 seconds and the front entrance became blocked at 90 seconds*. This scenario was the closest to the condition that occurred on Feb. 20, recognizing that the simulations did not account for any impairment of movement associated with high temperatures, smoke and toxic gas levels that were produced in the actual fire. The time for total evacuation increased to 330 seconds, with the bulk of the people forced to evacuate through the only (known) exit in the main barroom. (No provision was made to allow escape through broken windows). In this case, only 91 people used the front entrance and 35 used either the platform door or the kitchen door, numbers that were consistent with those reported by the *Providence Journal*. The total number of people evacuated in this scenario was only 399 since it was assumed that the 21 occupants who were in the entrance corridor when it became blocked at 90 seconds were trapped.

Scenario 3 investigated the impact of *doubling the width of the most restrictive element at the front entrance*. Figure 6-15 is one frame grabbed from the Simulex computer simulation indicating the initial

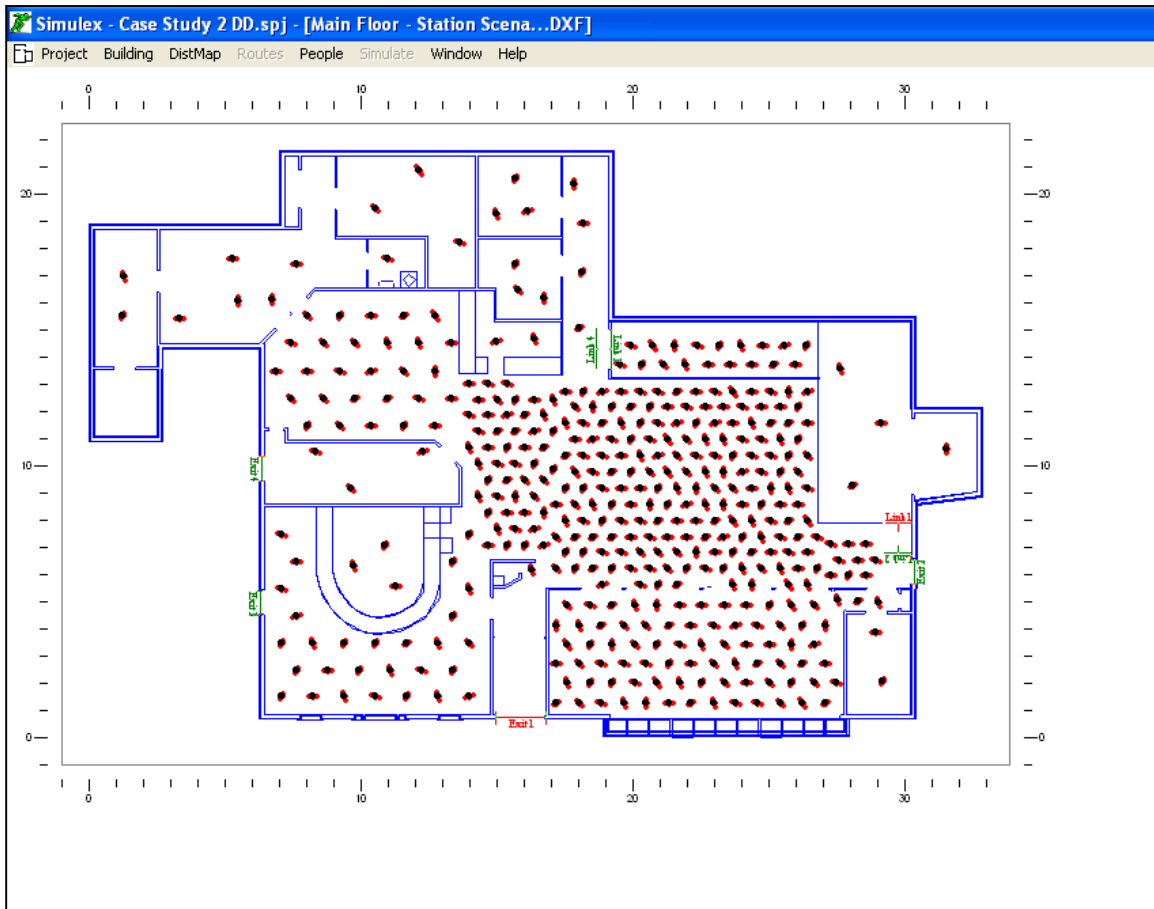


Figure 6-15. Initial distribution of 420 simulated nightclub patrons and employees

population and distribution of patrons and employees. (This was typical of the initial conditions for all of the simulations.) The purpose was to see how this affected the evacuation time in the event that one of the other exits became blocked (e.g., due to construction, negligence or a criminal act). Simulex and buildingEXODUS calculated a total egress exit time of 196 seconds \pm 2 seconds, almost identical to the baseline case in scenario 1. The main difference in the outcome for scenario 3 was the larger number of occupants using the front entrance to escape, about 87 % of the total. Assuming that doubling the width of the restrictive front entrance would also have reduced the possibility for a crowd crush to develop, this change would bring the level of safety equivalent to what was implied by the current model codes.

The last row in Table 6-2 applies to a modified form of scenario 2 (Scenario 2*), in which it was assumed that *the main door did not become blocked by the crush of the crowd (in spite of the single door width at the entrance to the ticket taker area), and that the platform door became impassable after 30 seconds*. It is interesting to see that while the distribution of occupants through the different doorways is essentially the same as was calculated for scenario 3, the total evacuation time increased to between 308 seconds and 341 seconds. This results from the decision algorithm that required occupants to choose the closest exit, even if the queue was long. One could argue that many of the people waiting to go out the front door would have chosen the barroom door (which remained clear for most of the evacuation period) as a

logical alternative, even though it may have been a bit more distant. The counter argument is that the barroom exit sign could have been obscured by smoke, making that door a reasonable alternative only for those familiar with the nightclub.

Figures 6-16 and 6-17 compare the cumulative population that was evacuated as a function of time for the scenarios described above, based upon the results of buildingEXODUS [39] and Simulex [37, 38] respectively. If one draws a vertical line up from the time scale at 90 seconds, the total number of people who remained in the nightclub at that time can be determined.

Ninety seconds had significance on Feb. 20 because that was about the time the front entrance became blocked and, according to the fire dynamics simulations, was a point where the conditions were becoming untenable throughout the building. The last column in Table 6-2 lists the population remaining for both the buildingEXODUS and Simulex simulations. Note that buildingEXODUS, when compared to Simulex, consistently provided a more conservative (i.e., a slower) rate of egress, which is consistent with the conservative flow rates chosen for the exit doors in buildingEXODUS.

Somewhere between 166 and 208 people were calculated to remain in the building 90 seconds after the fire began for the scenario in which the building met current national model code requirements. This number jumped to 271 for scenario 2, with the platform door blocked (recall that the front door remained open during the first 90 seconds). Doubling the entrance door width in scenario 3 brought the number of people remaining in the building 90 seconds into the fire back down to the range calculated for scenario 1. Finally, since the crowd-crush had not occurred prior to 90 seconds, the calculation for the 2* scenario is essentially the same as for scenario 2.

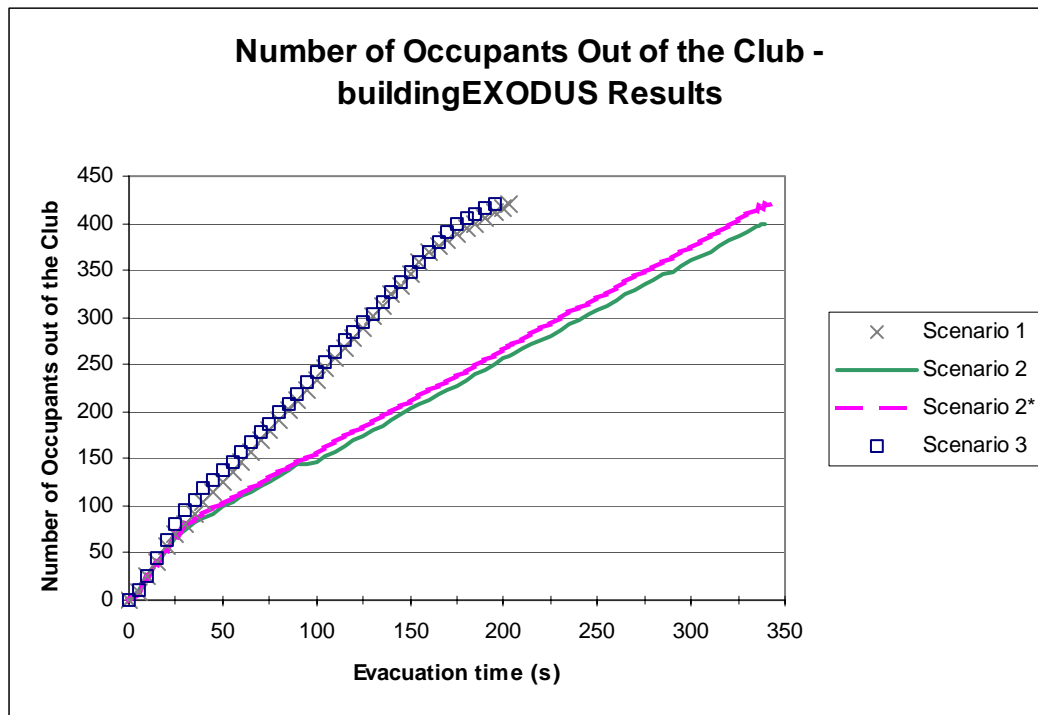


Figure 6-16. Cumulative plot of evacuation from building for different scenarios calculated from buildingEXODUS [39]

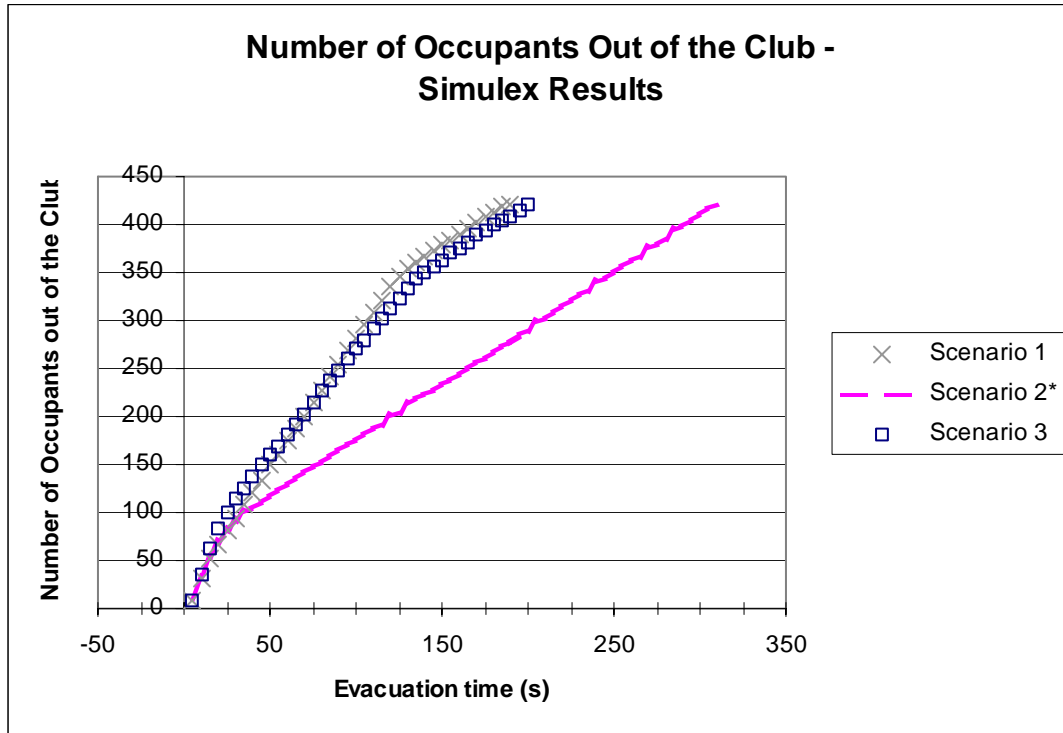


Figure 6-17. Cumulative plot of evacuation from building for different scenarios calculated from Simulex [37, 38]

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